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option of the in-town landfill undesirable as compared to existing, currently-operating landfills out of town.

Cost – For out-of-town landfills, the relative capital costs are moderate to high (depending on the distance of transportation of wastes). Out-of-town disposal in hazardous waste landfills is the most expensive of the landfill options, while disposal in a non-hazardous landfill is less expensive. The cost for an in-town landfill would be high because of the cost of new construction.

Conclusion – Landfilling is an effective containment option for the contaminated soils and sediments. It is implementable when using existing out-of-town facilities although very difficult to implement in town, as new construction would be required. As a result, out-of-town landfills are retained for further consideration, and in-town landfills are eliminated.

2.4.5 Containment

The following containment technologies and process options for contaminated soils and sediments are evaluated in this section.

- Horizontal Barriers
  - Impermeable Cap
  - Permeable Cover
  - Subaqueous Permeable Cover
  - Subaqueous Impermeable Cap
  - Rip Rap
  - Culvert
- Vertical Barriers
  - Sheet Pile
  - Slurry Wall

Impermeable Cap

Capping involves installing an impermeable barrier over the contaminated soils or sediments to restrict access and reduce infiltration of precipitation into the subsurface. Impermeable and low-permeability barriers are appropriate where soil or sediment contamination threatens groundwater or surface water. Regrading of soils prior to capping may be required. Cap materials can either be natural or synthetic. Frequently used materials include low-permeability clays such as bentonite and synthetic membranes such as high-density polyethylene (HDPE), polyvinyl chloride (PVC), and Hypalon. These materials are typically covered with a clean fill and vegetation (grass) or asphalt to protect them against damage caused by puncturing and weathering. Capping will involve regrading to provide for erosion and drainage control.

Effectiveness – Capping can achieve RAOs associated with preventing exposure to contaminated soils, sediments, and waste materials and minimizing the migration of contaminants from the study area. Capping is a reliable technology that would reduce risk to human health by providing a barrier between contaminated soils and potential receptors, thus significantly limiting fugitive dust emissions and direct contact with contaminated soils and sediments. Capping would be effective in limiting the infiltration of precipitation and consequently the potential leaching of contaminants from unsaturated soils, sediments, and waste materials to groundwater. Capping alone would not prevent potential contaminant leaching to groundwater from saturated soils. Because capping does not alter the natural flow of groundwater through the subsurface, contaminated saturated zone soils would remain a continuing source of contamination to groundwater. Capping only isolates existing contamination, offering no decrease in contaminant levels. Since contaminants remain in place, the long-term effectiveness of capping depends on adequate long-term cap maintenance. During remedial activities, fugitive dust emissions would have to be controlled to minimize effects on human health and the environment. Emissions can be safely and adequately controlled using standard engineering controls such as dust suppressants and enclosures.

Implementability – The construction of an impermeable cap is readily implementable at the study area. A variety of proven capping materials can be used, including soils, clay soils, geosynthetic membranes, and combinations of these materials. Due to the grade differential across the study area and the close proximity of contaminated soils and sediments to the study area boundaries, significant earthwork may be required to achieve proper slopes for cap stability and surface water runoff control. Remedial activities involving capping are relatively common and can be conducted by many contractors. No permits or other administrative requirements would be necessary for on-site activities. Because the contaminated soil-waste/fill and contaminated sediments would remain in the study area, the need for TSD facilities is not a concern. However, deed restrictions and ELURs would be required in conjunction with capping to limit the future use of the capped areas or actions that may damage the cap. Long-term groundwater monitoring would also be implemented.

Cost – The capital costs for conventional cap construction are expected to be moderate. O&M costs are low for an impermeable cap.

Conclusion – Capping would prevent exposure to contaminated soils and sediments and minimize migration of source contaminants. Because capping alone does not prevent saturated soil contaminants from migrating in the groundwater, other technologies, such as vertical barriers, may be considered and used in conjunction with capping when groundwater issues are addressed under OU2. Capping with an impermeable barrier will be retained for further consideration.

Permeable Cover

Permeable covers and soil caps are lower cost alternatives to conventional caps. Permeable covers and soil caps are placed over contaminated soils and sediments to prevent access to surficial and near-surface contaminants. Because they provide little or no reduction in infiltration, they are appropriate for use where direct exposure to contaminated material is to be prevented and contaminant leaching to groundwater is not a concern.

Effectiveness – Installation of a permeable cover or soil cap would achieve the RAO for preventing direct exposure to contaminated soils and sediments but would not achieve the RAO for protection of the environment, which is to minimize leaching of contaminants to groundwater. A permeable cover or soil cap would not be effective in preventing infiltration or potential leaching of soil and sediment contaminants to groundwater. Because contaminated soils and sediments remain in place, the effectiveness of a permeable cover or soil cap in preventing direct exposure to contaminants depends on adequate cover maintenance.

Implementability – Construction of a permeable cover or soil cap is readily implementable at the study area. Specialized construction techniques are not required, and qualified contractors and necessary cover materials are readily available. Earthwork requirements would be similar to those described for an impermeable cap. No permits or other administrative requirements would be necessary. Because no off-site activities would be occurring, the need for TSD facilities is not a concern. Deed restrictions and ELURs would be required in conjunction with the cover to limit the future use of or intrusion into the covered areas.

Cost – The capital and O&M costs for a permeable cover are low.

Conclusion – Although a permeable cover or soil cap would not achieve all RAOs, use of a permeable cover or soil cap will be retained for further consideration for use in areas where direct contact exposure to contaminated media is the primary concern.

Subaqueous Permeable Cover

Subaqueous permeable capping or covering is a means of containing contaminated sediments. The principal concept for reducing long-term environmental effects is to cover the contaminated material with clean dredged material. By keeping contaminated sediment in the waterway, stable geochemical and geohydrologic conditions are maintained in place within the sediment, minimizing release of contaminants to surface water, groundwater, and air.

Permeable cover options include placing natural silts, fill, sand, gravel, and/or crushed stone directly over the contaminated area. The selection of materials and associated thickness are chosen based on their ability to physically isolate contaminated sediment from the aquatic environment as well as maintain surface water flow. A cover comprised of materials similar to the existing substrate, but with more coarse materials to provide erosion resistance, is recommended for use in underwater containment. The larger particle sizes, typical of sand and crushed stone, would also allow for more uniform placement within areas of strong tidal action or underwater currents. The coarse fraction within the cover would protect the cap itself and limit erosion due to wave action and underwater currents.

Effectiveness – Since a subaqueous permeable cover offers no removal or treatment, it would not reduce the toxicity or volume of contaminated sediment. However, the cover would be effective in minimizing human and environmental exposures due to direct contact with contaminated sediment. The effectiveness of a subaqueous cover in preventing potential migration of contaminants depends on its ability to resist erosion and prevent exposure and migration of the contaminated media. Use of appropriately sized and graded capping materials would limit upward migration of contaminated sediments. Migration of dissolved contaminants through the cover could occur under the force of an upward groundwater gradient, potentially contaminating the cover materials over time. Wave action and local currents may limit the long-term integrity of a subaqueous cover in the marine environment, especially in the high-energy areas near the shore. Short-term risks to human health and the environment may be associated with cover installation, as sediments would be stirred up. However, the use of proper equipment and turbidity control measures would reduce these risks.

The long-term effectiveness of the subaqueous permeable cover could be monitored by periodically inspecting the cover to ensure that its thickness has not decreased and collecting sediment samples to determine whether contaminants have been released from under the cover. Periodic maintenance would be required to replace any cover materials that had eroded.

Implementability – Placement of a subaqueous permeable cover is implementable by companies with trained personnel qualified to handle contaminated sediment dredging, grading, and erosion control operations in an aqueous environment. All on-site personnel must be trained in hazardous waste site operations. Proper placement would require considerations of wave action, local currents, and tidal fluctuations. Turbidity control measures would be required to minimize resuspension of contaminated sediment and to limit its migration during capping operations. Installation could be conducted by land-based and barge-mounted equipment. Proper anchoring of the cover and maintenance to ensure its long-term integrity may be difficult.

In addition, the applicability of ARARs must be evaluated on a location-specific basis.

Cost – The capital and O&M costs are low for a subaqueous permeable cover comprised of sand and crushed stone layers.

Conclusion – A subaqueous permeable cover can be an effective and implementable containment technology for contaminated sediments. Subaqueous permeable covers will be retained for further consideration for isolating study area sediments.

Subaqueous Impermeable Cap

Subaqueous impermeable capping is similar to subaqueous permeable covering, except that water and contaminants are not able to pass through the cap. The principal concept for reducing long-term environmental effects is to physically isolate the contaminated material with an impermeable barrier of natural and/or geosynthetic material.

As with the permeable cover, the selection of materials and associated thickness for the impermeable cap are chosen based on their ability to physically isolate contaminated sediment from the aquatic environment. Anchoring of the cap is necessary to prevent movement resulting from tidal action or underwater currents.

Effectiveness – Since a subaqueous impermeable cap offers no removal or treatment, it would not reduce the toxicity or volume of contaminated sediment. However, the cap would be effective in minimizing human and environmental exposures due to direct contact with contaminated sediment. Migration of dissolved contaminants through the cap would be minimal due to the impermeable layers. Short-term risks to human health and the environment may be associated with cap installation, as sediments would be stirred up. However, the use of proper equipment and turbidity control measures would reduce these risks.

A major concern for the effectiveness of an impermeable cap in underwater applications is maintaining its integrity because of potential forces acting on it. Any water movement or gas formation under the cap could become trapped and stress the integrity of the cap. The discharge of groundwater to the sediment area could also cause upward forces on the cap.

The long-term effectiveness of the subaqueous impermeable cap could be monitored by periodically inspecting the cap to ensure its integrity. Periodic maintenance would be required to repair the cap and replace any top-layer cover materials that had eroded.

Implementability – Placement of a subaqueous impermeable cap is implementable by companies with trained personnel qualified to handle contaminated sediment dredging, grading, and erosion control operations in an aqueous environment. Placement of a geomembrane liner may be difficult, as it would tend to float on the water surface during installation. All on-site personnel must be trained in hazardous waste site operations. Proper cap placement would require considerations of wave action, local currents, and tidal fluctuations. Turbidity control measures would be required to minimize resuspension of contaminated sediment and to limit its migration during capping operations. Installation could be conducted by land-based and barge-mounted equipment. Proper anchoring of the cap and maintenance to ensure its long-term integrity is needed.

Cost – The capital and O&M costs are moderate for a subaqueous impermeable cap comprised of natural and geosynthetic layers.

Conclusion – The subaqueous impermeable cap is eliminated from further consideration due primarily to groundwater discharge into the sediment area, which could cause upward forces to act on the cap.

Rip Rap

Rip rap material, consisting of 6- to 8-inch average diameter rock, is used to line banks and channels to prevent erosion and migration of sediments. It also serves to prevent direct exposure to contaminated sediments. A geosynthetic fabric would likely be placed beneath the rip rap to further stabilize the bank and contain the contaminated sediments.

Effectiveness – Rip rap would be effective for limiting exposure to and preventing migration of contaminated sediments. However, it is not an impermeable layer and would not prevent infiltration or potential leaching of sediment contaminants to groundwater. Because contaminated sediments remain in place, the effectiveness of a rip rap lining depends on its adequate maintenance.

Implementability – Placing rip rap and geosynthetic fabric in Ferry Creek or along the shore is readily implementable at the study area. Some excavation or dredging of sediments and soils in the creek (up to approximately 18 inches) may be necessary to maintain the hydraulic grade of the creek bed to allow proper creek flow. Qualified contractors and materials are readily available.

Cost – The cost for rip rap would be low.

Conclusion – Containment of contaminated sediments by rip rap is retained for further evaluation.

Culvert

Culverting Ferry Creek would involve installing piping in the existing creek bed and then backfilling to the surrounding grade. Culverting and backfilling would prevent direct contact with sediments and also minimize erosion and migration of contaminated sediment within the creek bed. The culvert would consist of reinforced concrete pipe, sized adequately to maintain the discharge from Ferry Creek. Some contaminated sediment would likely be dredged for the placement of the culvert in order to maintain the current hydraulic elevations. The concrete pipe would then be covered with geotextile, gravel, and clean soil and the area above the finished culvert vegetated.

Effectiveness – Installation of a culvert would be effective for limiting exposure to and preventing migration of contaminated sediments. Backfilling to the surrounding grade would also help to prevent infiltration and potential leaching of sediment contaminants to groundwater. Because the creek flow would be contained inside the concrete pipe, scouring of sediments in the creek bed by turbulent flow and tidal influence would be eliminated.

Implementability – Culverting Ferry Creek is implementable at the study area. Some excavation or dredging of sediments and soils in the creek may be necessary to maintain the hydraulic grade of the culvert to allow proper flow. Qualified contractors and materials are readily available.

Cost – The cost for the installation of a culvert along Ferry Creek would be moderate.

Conclusion – Containment of contaminated sediments by the installation of a culvert is retained for further evaluation.

Sheet Pile

Steel sheet piles, aligned and interlocked at the surface, are driven into the ground to create vertical barrier systems. Typically, sheet pile barriers are used in construction to provide structural stability to walls in excavations or open cuts but can also be used as vertical barriers to prevent the migration of contaminants, which is the application for this study area. Steel sheet piles come in various shapes and interlocks, e.g., straight web type, arch web type, and deep arch web type, and are installed using heavy equipment such as a drop hammer or a vibratory hammer. Often a cap block or driving head is placed on the top edge to prevent the driving equipment from damaging the piles. The piles are driven a few feet at a time over the entire length of the wall. This process is repeated until the piles are all driven to the desired depth (usually until a low permeable layer is reached).

Effectiveness – When first placed in the ground, sheet piling cut-off barriers are quite permeable at the interlocks. The edge interlocks, which are loose to facilitate placement, allow easy passage of groundwater. With time, however, fine soil particles are washed into the seams and water cut-off is effected. Considering the texture of soils at the study area (silty sand), the sealing process would be quite slow and might never seal. In some cases, the seams could be grouted but this procedure is costly. The performance life of a sheet-piling wall can vary between 7 and 40 years, depending on the condition of the soil in which the wall is installed (EPA, 1985).

Implementability – Sheet pile installation is readily implementable. The equipment and resources necessary to construct the barrier are available from a number of contractors. Given the soil conditions at the study area, it is assumed that sheet piles could easily be driven into the ground; however if the bedrock surface is fractured, a suitable low permeability stratum in which to key the vertical barrier may not be present.

Cost – The capital cost of sheet piling is moderate and the O&M costs are low.

Conclusion – Concerns about groundwater leakage through the sheet piling seams eliminate this technology from consideration for a permanent vertical barrier.

Slurry Walls

Slurry walls are subsurface barriers used to reduce lateral groundwater flow in unconsolidated materials. The term slurry wall is used to describe barriers constructed in a vertical trench that is excavated under a slurry. The slurry, usually a mixture of bentonite and water, acts essentially like a drilling fluid, shoring the walls of the trench to prevent collapse and to reduce infiltration of groundwater during excavation. The excavated trench is backfilled with low-permeability material such as a soil-bentonite-water mixture or a slurry of cement, bentonite, and water.

Slurry walls can be placed hydraulically upgradient of a contaminant source area to divert clean groundwater and reduce the generation of leachate. They are often installed circumferentially around the source area to reduce the flow of clean groundwater entering and contaminated groundwater leaving the site. For maximum effectiveness, slurry walls must be "keyed-in" to a low permeability layer such as clay or competent bedrock.

Effectiveness – Slurry walls are an effective means of reducing lateral groundwater flow through unconsolidated materials. The wall permeability depends primarily on the backfill material. The most common material used to construct a slurry wall is a soil-bentonite slurry mixture. These materials have the lowest permeabilities (approximately 1×10^{-8} cm/sec) and the widest range of chemical compatibilities (EPA, 1985).

The complex geology and hydrogeology of the study area will likely limit the effectiveness of slurry walls for complete containment. The absence of a low permeability clay layer and the presence of fractured bedrock will not provide an adequate layer to key in the slurry wall.

Implementability – Slurry walls are readily implementable. Common trenching techniques and equipment such as excavators and clam shell dredges are employed in their construction. The equipment and resources necessary for slurry wall installation are readily available. Consideration of the need for TSD facilities is not applicable to this technology.

Cost – The capital and O&M costs of slurry walls are low.

Conclusion – Due to concerns about the effectiveness of this technology for reducing the flow of groundwater through source area soils and sediments, slurry walls are eliminated from further consideration.

2.4.6 Treatment

The following treatment technologies and process options for contaminated soils, wetland soils, and sediments are evaluated in this section.

- Immobilization
  - Solidification/Stabilization
- Thermal Treatment
  - Incineration
  - Thermal Desorption
  - Vitrification
- Physical Treatment
  - Soil Flushing
  - Soil Washing
  - Soil Vapor Extraction
- Chemical Treatment
  - Chemical Oxidation
  - Solvent Extraction
- Biological Treatment
  - Aerobic Biodegradation

Discussion of in situ treatment indicates that treatment takes place in the ground without excavation. Ex situ treatment implies the removal of waste from the ground and transport to a treatment unit either on the site, in town, or out of town. A high, moderate, or low cost option is compared to the other process options within the treatment GRA.

Solidification/Stabilization

Solidification/stabilization processes involve mixing excavated contaminated materials with proportional amounts of treatment reagents to physically or chemically decrease the mobility of contaminants in the waste and convert the contaminants to a less soluble, less mobile, or less toxic form. The end product may be a standing monolithic solid or may have a crumbly, soil-like consistency, depending on the amount and type of reagent added. A typical treatment system consists of a materials feed system, a reaction tank equipped with mixing equipment, and an area for curing. The effectiveness of the immobilization process is evaluated by running leaching tests such as TCLP or SPLP on the treated materials.

Portland cement and pozzolanic (silica-bearing substances) materials such as fly ash are widely used as immobilization reagents because of their ready availability and effectiveness in binding contaminants to minimize leaching. A number of additives have been developed for use with cement and pozzolanic materials to improve the physical characteristics and decrease the leaching losses from the resulting solidified material. In addition to cement and pozzolanic materials, other reagents such as organic polymers, thermoplastic materials, and sorbents are also utilized; however, these materials are less effective in binding the contaminants, and the resultant products are more susceptible to degradation and leaching than materials stabilized with cement or pozzolanic materials.

Solidification/stabilization has reportedly been capable of immobilizing up to 99 percent of inorganic contaminants at some sites, but was not successful at significantly immobilizing organic contaminants (EPA/540/5-89/001a, 1989). One study indicated that volatile organic contaminants did not leach from the solidified matrix; however, the study attributed the removal of VOCs in part to volatilization during extraction and mixing (Longest, 1989). Another study found that PCBs were 100 percent immobilized, but also suggested that TCLP results from samples of the soil before treatment indicated no PCB leaching (EPA/540/5-89/005a, 1990).

<u>Effectiveness</u> – Solidification/stabilization processes have been widely demonstrated in full-scale remediation projects to immobilize metals in soils. Cement- and pozzolan-based methods have been effective for immobilizing heavy metals including lead. Treatability testing conducted on the Raymark Facility soils indicates that mixing soils with 20 percent cement provides effective stabilization of lead and asbestos with a waste volume increase of approximately 25 percent (HNUS, 1994a). Additionally, the cured mix can be solidified as a soil-like product that could be more easily placed as fill.

Immobilizing of organic compounds may be effective in some cases. Data from several bench-scale studies indicate that immobilization of semi-volatile organic compounds, particularly polynuclear aromatic hydrocarbons (PAHs), is possible. PCBs immobilization may be effective, particularly where initial concentrations are low. However, limited test data are available to support this conclusion (EPA, 1990). Solidification/stabilization would likely be effective in immobilizing lead and other metals, even at high concentrations, to prevent their leaching into the groundwater; however, immobilization of all organic contaminants is unlikely, although some reduction in leachability for select organics may occur.

Solidification should be capable of handling the volume of contaminated soils, wetland soils, and sediments at the study area. The process should be effective in significantly reducing the mobility of the COC metals and asbestos present in the soil-waste/fill and sediments. The treated residual must be tested prior to disposal to ensure that disposal requirements are met. Implementation should not cause any adverse effects on human health and the environment.

<u>Implementability</u> – Solidification/stabilization is an implementable technology for soils, wetland soils, and sediments in the study area but would require significant staging. The equipment and resources necessary to treat the soils, wetland soils, and sediments are available, with several vendors capable of performing this work. If treatment is conducted either in situ or ex situ, space is necessary to build or stage treatment equipment; constraints such as meeting TSD facility requirements and facility monitoring are also concerns. If the treatment is conducted out of town, some facilities are available that would be able to treat this waste. Transportation and TSD facility requirements must be met for out-of-town treatment. If solidification is chosen as a treatment option, it would probably be better implemented in situ at the study area due to the large extent of

waste. Also, less effort would be required to stage equipment for in situ treatment than for ex situ treatment.

Cost – The relative capital and O&M costs are moderate for cement-based solidification/stabilization methods.

Conclusion – In situ solidification/stabilization is an effective and implementable technology for immobilizing metals and asbestos in contaminated soils and sediments and can provide stabilization for some organics. Ex situ cement-based solidification of the contaminated soils and sediments should be effective to immobilize COC metals and asbestos in soils and sediments but may be difficult to implement; in situ solidification would be more easily implemented. Both in situ and ex situ cement-based solidification are retained for further consideration.

Incineration

Incineration is a thermal oxidation process that uses high-temperature, controlled flame combustion in an enclosed reactor to decompose organics in solids, liquids, and gases. Carbon and hydrogen waste components are converted to carbon dioxide and water, respectively. Chlorine, if present, is mostly converted to hydrochloric acid. Other combustion products are also formed in smaller quantities and may include carbon monoxide, nitrogen oxides, and free chlorine and fluorine. Inorganics are not treated in incineration and may, in some situations, become more toxic due to a concentration effect. Incineration produces a solid stream from the incombustible portion of the original material, which is removed as bottom and fly ash, detoxified soil, and possibly other solid treatment residuals. If a wet scrubber air pollution control system is used, a liquid waste stream could also be generated. Depending on the original waste stream, process residuals may require further treatment and/or disposal. The rotary kiln incinerator, which is capable of burning a broad range of hazardous solids, slurries, liquids, and gases, is the most common and versatile type of incinerator. Other types of incinerators capable of treating contaminated soils and sediments include the circulating bed, multiple hearth, and infrared incinerators.

Effectiveness – Incineration is a highly proven technology to treat wastes containing high concentrations of organics. Incinerators have successfully been demonstrated to destroy refractory compounds such as PCBs as well as other organic contaminants present in study area soils, sediments, and waste materials at efficiencies in excess of 99.99 percent. Incineration should be capable of achieving the remediation goals for organics. Incineration does not destroy asbestos or metals. Metals in the waste matrix will form metal oxides that enter the gas stream or will be concentrated in the treated soil or sediment. Asbestos will either enter the gas stream and be captured in the pollution control equipment (scrubber, filters) or will become concentrated in the treated soil or sediment. Treated soils or sediments may require additional treatment to remove or immobilize metals and asbestos prior to disposal. Conventional air pollution control equipment such as scrubbers and baghouse dust filters will be required to remove acid gas and particulates. Air emissions from the incinerator will be monitored closely to ensure that human health and the environment are not adversely affected.

Implementability – Incineration, whether conducted at an in-town or out-of-town locations, is implementable. The equipment and resources necessary to incinerate soils and sediments are available, and several vendors are capable of performing this work. The large volume of contaminated soils and sediments at the study area may pose logistical problems for incineration; several facilities would likely be needed to treat the large volume. Out-of-town TSD facilities are available that could treat study area soils, sediments, and waste materials. If incineration is conducted out of town, transportation requirements would be applicable and the off-site facility would have to meet RCRA permit requirements. Incineration would have to meet the substantive requirements of the RCRA incineration regulations; therefore, incineration conducted in town would not be considered a viable option. These regulations would require a trial burn for incineration to demonstrate destruction and removal efficiency; regulate emissions of hydrogen chloride, nitric and sulfuric oxides, and particulates; and require monitoring for carbon monoxide. In-town incineration would also have to meet Connecticut Air Quality Standards and Connecticut Hazardous Waste Site Management regulations, which include restrictions on facility siting, construction, and operation.

Costs – The relative capital and O&M costs are high for incineration.

Conclusion – Incineration is an effective option for destroying the organics present in the study area contaminated soils and sediments; however, inorganics would be left unaffected.

Incineration would require substantial logistics and restrictions due to the large volumes to be treated. Due to the lack of treatment of inorganic contaminants and its high cost, incineration is eliminated from further consideration.

Thermal Desorption

Thermal desorption is a treatment process that uses heat and physical agitation to volatilize organic contaminants from soils, wetland soils, and sediments; the resulting vapor stream is subsequently treated to collect or destroy the contaminants. A typical thermal desorption system consists of a rotary drum thermal processor equipped with heat transfer surfaces, and a vapor treatment system. Direct-fired and indirectly heated systems (generally heated by circulating hot oil) are available. Temperatures used in the thermal processor are contaminant- and matrix-specific, with a range of approximately 150 degrees Fahrenheit (F) to 800 degrees F. Most units incorporate mechanical agitation during treatment to facilitate complete desorption of organics. An induced air flow conveys the volatilized organics through a gas treatment system, such as a carbon adsorption unit, a thermal oxidizer, or a condenser unit. The air stream is then discharged through a stack. Thermal desorption is a well-demonstrated technology for industrial sludge and product drying applications, but its use for remediation of soils and sediments is less demonstrated. The process is most effective on volatile organic compounds, but units operating at higher temperatures are also capable of treating semi-volatile organics and PCBs.

<u>Effectiveness</u> – Thermal desorption should be capable of accommodating the volumes of contaminated soils, wetland soils, and sediments at the study area. Thermal desorption at a relatively high temperature would be expected to achieve the remediation goals for the PCBs, VOCs, and most SVOCs. Treatability testing, under static conditions, of Raymark soil-waste/fill demonstrated removal of PCBs (Aroclors 1262 and 1268) to below 2 µg/kg at an operating temperature of 1000 degrees F and a 60 minute residence time (HNUS, 1994b). Metals and asbestos would not be addressed by this technology. The effectiveness of thermal desorption is dependent primarily on the boiling point of the contaminant. For volatile organics such as trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA), with relatively low boiling points, nearly complete removal from the soils and sediments would be expected at relatively low operating temperatures. Many of the organics present in the study area contaminated soils

and sediments have much higher boiling points; for example, PCBs have boiling points in excess of 600 degrees F. The upper temperature range for thermal desorption approaches the lower temperature range for incineration, and some thermal desorption systems are permitted as incinerators.

Implementability – Thermal desorption is implementable. The equipment and resources necessary to treat the soils and sediments are available, with several vendors capable of performing this work. Connecticut Air Quality Standards would have to be met. Few, if any, out-of-town thermal desorption facilities would be able to accept these soils and sediments; therefore, consideration of thermal desorption is effectively limited to an in-town location.

Thermal desorption, if selected, would likely be included as part of a treatment train of multiple process options due to its ineffectiveness for inorganic contaminants.

Cost – The relative capital and O&M costs for thermal desorption are moderate.

Conclusion – Thermal desorption is an effective and implementable technology to remove organics from contaminated soils and sediments. Thermal desorption will be retained for further consideration for treating study area soils, sediments, and waste materials.

Vitrification

Vitrification is a thermal destruction process that immobilizes soil contaminants by converting the contaminated soils or sediments to a chemically inert, stable, glass product. Vitrification is conducted by applying energy through electrodes inserted around the area to be melted. Wastes are heated to temperatures of 1,350 degrees F to 3,000 degrees F inside a refractory vessel, forming a molten glass and thereby destroying organics and immobilizing metals and asbestos. Organics in the waste matrix are volatilized, and the resulting gases are oxidized in the turbulent zone above the glass. Metals and asbestos are retained in the glass which, when cooled, is a stable, non-leachable, vitreous solid. This glassy residual may then be landfilled or used as backfill.

Effectiveness – Vitrification is an effective technology to destroy organics and immobilize metals and asbestos. The vitrification process should be capable of achieving the remediation goals for organics, metals, and asbestos. Using this process, inorganic contaminants would be immobilized while organic contaminants would be destroyed to below clean-up levels. Human health and environmental concerns are similar to those for incineration. Air pollution control equipment would be necessary to remove particulates and acid gases. Vitrification should be reliable with respect to the study area contaminants and conditions. Short-term concerns associated with vitrification are the potential risks resulting from volatilization; however, study area soils and sediments contain few VOCs.

Implementability – Vitrification is implementable for study area soils, wetland soils, and sediments. For vitrification conducted in town, the close proximity of the contaminated soils and sediments to the homes and public roadways may pose problems for set-up and control of the process. For out-of-town vitrification, few facilities would be able to treat these soils and sediments. Thus, treatment is effectively limited to in-town processes. The equipment and resources necessary to vitrify the soils and sediments are commercially available from a few vendors. However, the overall capacities of the vitrification units are typically low and may be inadequate for the large volume of soil and sediment requiring treatment. The vitrification process is extremely energy intensive and requires sophisticated machinery and highly trained personnel for operation. Application of this technology has been primarily limited to treating radioactive or highly toxic wastes.

Cost – The relative capital costs are high. Operation costs are also high because of intensive energy usage, although maintenance costs are low.

Conclusion – Vitrification is a potentially effective technology for treatment of study area soils, wetland soils, and sediments. Although the costs are high, vitrification provides a high level of immobilization of all contaminants and is therefore retained for further consideration.

Soil Flushing

Soil flushing is a process that uses a closed loop recirculation system of injection and extraction wells to remove contaminants from the saturated and unsaturated soils and sediments. Under soil flushing, water, with or without other additives, is sprayed onto or injected into the soils or sediments. Additives are used to increase the mobility of the contaminants. To remove organics, surfactants or alkalis are commonly used. Acids, alkalis, oxidizers, reducing agents, and/or complexing agents are commonly used to remove inorganics. Collection of the flushing agent solvent is an important step. At the collection point, treatment systems such as air stripping or carbon adsorption are then utilized to separate the contaminants from the extracted water. The treated water is recirculated through the system by reinjection into the contaminated soil.

Effectiveness – Soil flushing may be effective in treating some of the organic and inorganic contaminants at the study area; however, several factors can limit its effectiveness. Of primary concern is the difficulty of treating organics and inorganics simultaneously and the ability to capture mobilized contaminants. Additionally, because of their low water solubility, PCBs may not be readily flushed from soils, and asbestos, which is insoluble in water, would not be removed. Some other effectiveness concerns are the ability to contact all the soils or sediments, the ability to separate the contaminants from the flushing agent, and the ability to monitor compliance. For the study area, the heterogeneity and stratification of the soils make contact with soils and capture of mobilized contaminants uncertain. Additionally, the burdened flushing fluids would likely contain significant concentrations of contaminants in highly mobile forms; a significant threat to human health and the environment might result if the contaminated fluids are not completely captured.

Implementability – Soil flushing would be difficult to implement at the study area. A primary concern is the difficulty of ensuring complete capture of mobilized contaminants and restrictions on underground injection of wastes mandated by state and federal regulations. If treatment is conducted at the study area, space is necessary to build or stage treatment equipment. TSD facility requirements must be met, and facility monitoring would be required. If soil flushing is chosen, then consideration of capturing the groundwater and recovering the flushed contaminants is critical. TSD facilities may be necessary if residuals such as spent carbon or biomass are generated during treatment of the captured water. The equipment and resources necessary to implement soil flushing are available, and a few vendors are capable of performing this work.

Cost – The capital and O&M costs of soil flushing are highly dependent on the cost of treating the extracted water. Because of the complex mixture of contaminants in the soils, sediments, and groundwater, the cost of implementing soil flushing at the study area is likely to be moderate.

Conclusion – Due to several effectiveness and implementability concerns, including a potential risk to human health and the environment, soil flushing will be eliminated from further consideration as a process option.

Soil Washing

Soil washing is a treatment process that removes contaminants from soils, wetland soils, and sediments by either dissolving or suspending them in the wash solution (which is later treated by conventional water treatment methods) or by concentrating them into a smaller volume of soil through standard particle size separation techniques. The concept of reducing soil contamination by particle size separation is based on the finding that most organic and inorganic contaminants in soil and sediments tend to bind to fine-sized clay and silt particles through surface adsorption. Soil washing relies heavily on this principle of separating highly contaminated fine materials from washed coarse materials to decrease the volume of particles that require treatment.

Soil washing is generally a water-based process; however, chemicals such as surfactants are sometimes added to the wash fluid to enhance removal of specific contaminants. Organic or inorganic compounds can be removed using this process. In the washing process, soils and sediments are screened and then scrubbed to break up soil aggregates and liberate fines. The surfaces of the coarse particles are "washed" by abrasive action and by desorption of contaminants upon contact with the washing solution. The contaminated fine particles typically require further treatment. Applicable processes to treat fine particles may include chemical extraction, biodegradation, immobilization, or destruction processes.

Effectiveness – Depending on the proportion of coarse and fine materials in the contaminated soils and sediments, soil washing can be effective in reducing the volume of material that requires intensive treatment. Soil washing would be effective for removal of both organic and inorganic contaminants from coarse material within the study area, minimizing the volume of materials requiring intensive treatment. Contaminants would be concentrated in the relatively smaller fine soil fraction or the wash solution; contaminant extraction from the fine fraction by the soil washing process would likely be incomplete. The fine fraction and wash solution would likely require additional treatment. Effective removal of the contaminants in the soil-waste/fill may require multiple cycles of treatment and could require additional, specialized treatment to immobilize the asbestos.

Implementability – Soil washing is a proven and reliable technology to remove organic and inorganic contaminants from soils and sediments with a relatively small fines fraction. The equipment and resources necessary to treat the soils and sediments are available, and several vendors are capable of performing this work. If treatment is conducted at the study area, space is necessary to build or stage treatment equipment; constraints such as meeting TSD facility requirements and facility monitoring are also concerns. Few, if any, off-site TSD facilities would be able to accept and treat the large volume of contaminated soils and sediments from the study area. This shortage effectively limits consideration of soil washing technologies to in-town processes.

Cost – The relative capital and O&M costs are moderate to high.

Conclusion – Soil washing is an effective and implementable technology to remove organics and inorganics from contaminated soils and sediments. Soil washing will be retained for further consideration for treating study area soils and sediments.

Soil Vapor Extraction

In situ vapor extraction is a well-demonstrated technology to remove VOCs from unsaturated or vadose zone soils. Vapor extraction uses an induced vacuum to pull air through the soil. The induced airflow desorbs VOCs from soil particles and transports the volatilized organic contaminants to a collection system at the ground surface. Upon withdrawal, the VOC-laden air stream is treated with a technique appropriate for the specific contaminants. The recovery rate increases as the vapor pressure of the VOC increases. Vapor treatment technologies may include carbon adsorption, condensation, and thermal or catalytic destruction.

A typical soil vapor extraction system is comprised of a vacuum pump connected to a network of vapor extraction wells situated within the contaminated area. The wells are typically constructed of PVC pipe set in permeable packing and screened within the unsaturated zone. Vapor extraction technology can potentially treat soils beneath structures and around utility lines, and to soil depths beyond the practical limits of excavation.

Variations on the standard vapor extraction process include thermally-enhanced systems, which use heat to accelerate VOC removal and potentially expand the array of treatable compounds, and air sparging systems, which use injected air to enhance VOC removal from unsaturated soils as well as from saturated soils and groundwater.

Effectiveness – The standard and thermally enhanced vapor extraction processes may be capable of effectively removing VOCs from unsaturated study area soils. The thermally-enhanced process is also potentially capable of removing some heavier organics. Both systems would achieve limited removal of contaminants from the groundwater due to interactions between contaminants in the groundwater and soils. Concurrent groundwater remediation is necessary to prevent groundwater contaminants from migrating back into the soils near the groundwater table fringe area when the vapor extraction system is shut off.

Vapor extraction with air sparging may be capable of treating VOC contamination in unsaturated and saturated soils at the study area. Due to increased air flow, air sparging would likely achieve RAOs faster than standard vapor extraction. The biodegradation aspect of the process may increase its potential effectiveness in treating a wider array of contaminants including some heavier organics.

Vapor extraction may be effective for removing VOCs from study area soils. However, vapor extraction technology is best suited to homogeneous, permeable soils; the heterogeneous nature of the soils at the study area may result in air channeling and inadequate treatment of portions of the soil. Additionally, vapor extraction would not be effective for treating metals, asbestos, and PCBs. Pre-design testing would have to be conducted to determine whether the soils are sufficiently permeable and homogeneous to allow effective treatment. Off-gas treatment would be required to protect human health and the environment during operation. Standard engineering controls and vapor treatment systems are capable of adequately collecting and treating VOC emissions.

Implementability – Vapor extraction technology is implementable at the Raymark Facility. Numerous vendors are capable of implementing most variations of this technology. The equipment and resources are also readily available. However, because of the shallow depth to groundwater, extensive dewatering would be required for effective treatment of the entire fill layer. Depending on the type of air treatment employed, residuals such as spent carbon, condensed VOCs, or acid scrubber sludge may require disposal.

Cost – Capital and O&M costs of standard vapor extraction and air sparging systems are low to moderate. Capital and O&M costs of thermally-enhanced vapor extraction systems are moderate.

Conclusion – Due to concerns about the effectiveness of vapor extraction for treating study area soils and its effectiveness primarily for VOCs, vapor extraction will be eliminated from further consideration.

Chemical Oxidation

Chemical oxidation is the process by which the oxidation state of a compound is raised in order to change the chemical form of the compound to render it less toxic or change its solubility or stability. This process has been used traditionally in ex situ applications to treat water, municipal wastewater, or industrial wastewater to destroy organic compounds, to remove soluble iron and manganese, or to control odors. In more recent times, chemical oxidants have been used in a variety of in situ pilot tests and full-scale applications to destroy residual organic compound contamination in soils and in aquifers.

Chemical oxidation has been used to reduce organic compound levels in saturated soils much faster than would occur through the gradual desorption and diffusion of groundwater contaminants for the aquifer materials. Typically, injection wells are installed to deliver the chemical oxidants to subsurface soils or into aquifers. The effectiveness of chemical oxidation is highly dependent on the ability for the oxidizing agents to come into contact with the contaminants. Therefore, the successful implementation in situ chemical oxidation is highly dependent on accurate characterization of site-specific geology, hydrogeology, and contaminant distribution to determine the proper siting of injection wells and the ability to deliver oxidizers into the contaminated aquifers. Soils and overburden aquifers can be characterized through hydrogeologic investigations, and injection wells can be designed to deliver the oxidizers where they can be most effective.

Effectiveness – Enhanced oxidation technology has been demonstrated to effectively oxidize a wide variety of organic compounds. The ease of treatment varies greatly depending on the particular contaminants. Effective destruction of some compounds requires much longer contact time than is required for oxidation of other organic compounds. The process is ineffective for inorganic constituents.

Implementability – Enhanced oxidation technology should be implementable at the study area. Currently, only a few vendors offer this technology, and most of the commercially available systems utilize hydrogen peroxide. This system would require storage and handling of hydrogen peroxide. Most oxidation systems require high maintenance because of manganese of iron fouling.

Cost – Capital and O&M costs are moderate; however operating costs can vary significantly depending on loading rate, contaminant types, and concentrations. Enhanced oxidation requires high energy usage, which can result in prohibitive costs, particularly if contaminants are difficult to destroy.

Conclusion – Due to concerns about the effectiveness of the oxidation of PCBs and the lack of effectiveness for inorganics, chemical oxidation will be eliminated from further consideration at this time.

Solvent Extraction

Solvent extraction is a treatment technology that employs a solvent to extract contaminants from soils, sediments, sludges, or wastewater. Extraction of organics is accomplished by various mechanisms including dissolution, formation of an emulsion or soluble chelation product, and chemical reaction. For metal extraction, acidification and chelation are the predominant mechanisms. The selection of the appropriate solvent depends on the chemical and physical properties of the contaminants present. Aqueous solutions including surfactants can be used to enhance removal or emulsification of a wide range of hydrophobic organic compounds. Dilute solutions of acids and bases can remove a wide range of metal ions.

Typical solvent extraction units include countercurrent extraction equipment, a pug mill, or a truck-loaded cement mixer. After contact and mixing, the solvent laden with contaminants is removed from soil or sediment by methods such as centrifugation or filtration. The extraction process results in a cleaned soil and a liquid waste stream that concentrates the extracted contaminants within the recovered solvent.

Contaminants within the waste stream are not destroyed, and the waste stream requires additional treatment or disposal. In many cases, contaminants retained in the solvent can be separated out, and the solvent can be re-used in the extraction process. Depending on the solvents used and the contaminants to be removed, soils or sediments may require supplemental treatment by soil washing or by extraction using additional solvents to target different contaminants.

Effectiveness – Solvent extraction is an effective technology to remove a wide range of inorganic and organic contaminants from medium to coarse soils and sediments. Commercial processes using secondary and tertiary amines have effectively removed PCBs, VOCs, and SVOCs from contaminated soil. Acid and alkaline solutions have been used to remove a wide range of metals. The process may have limited effectiveness for the study area soils due to the difficulty in formulating a suitable extraction fluid to treat a complex mixture of contaminants. Additionally, the variations in contaminant concentrations and contaminant distribution in the soil-waste/fill and contaminated sediments may require frequent adjustment or reformulation of the extraction fluid. The removal of metals and organics would likely have to be conducted in stages, using different solvents. Also, solvent extraction is ineffective for asbestos. A treatability study would be required to select the appropriate extraction solutions and determine operating parameters to ascertain whether effective treatment is possible.

Implementability – Solvent extraction is a widely demonstrated and reliable technology for the treatment of simple waste streams. Several commercial vendors are available that provide solvents to treat a variety of organic and inorganic contaminants. If treatment is conducted at an in-town location, space is necessary to build or stage treatment equipment. Few, if any, out-of-town TSD facilities using solvent extraction would be able to accept and treat the large volume of contaminated soils, sediments, and waste materials from the study area. This shortage effectively limits consideration of extraction technologies to in-town processes.

Cost – The relative capital and O&M costs of solvent extraction are moderate.

Conclusion – Because of concerns regarding the effectiveness of solvent extraction for treating study area soils and sediments, this technology will be eliminated from further consideration.

Aerobic Biodegradation

Ex situ aerobic biodegradation is a destruction process that uses microorganisms to chemically break down and detoxify organic compounds in the presence of oxygen. The organic compounds are used as energy sources and are metabolized by microorganisms such as bacteria, actinomycetes, and fungi. Biodegradation process residuals are carbon dioxide, water, and biomass. The biomass, which consists mainly of cell protein but also contains partially degraded constituents and intermediate biodegradation products, must be tested and may require additional treatment prior to disposal.

Several types of aerobic biodegradation have been used to treat contaminated soils. The primary ex situ methods are 1) slurrying the waste and treating it in a bioreactor and 2) using standard irrigation and soil mixing techniques to treat the soil directly on land (landfarming) or in an above-ground cell (composting). Landfarming is generally less effective than other ex situ techniques because operating parameters are difficult to control.

Effectiveness – The effectiveness of biodegradation is highly dependent on the nature and concentration of the contaminants. In general, aerobic degradation of organics is applicable to petroleum hydrocarbons, halogenated and non-halogenated aromatics, phenols, biphenyls, and pesticides (EPA/625/6-85/006, 1985). Biodegradation processes are not suitable for treating wastes with high levels of metals. The metals are not destroyed in the process and high metals concentrations may be toxic to the microorganisms.

Aerobic biodegradation may be effective for treating many of the organics in study area soils, although, heavy metals present in soils may decrease the effectiveness of the process. Biodegradation would likely have difficulty achieving PRGs for many of the organic COCs. The effectiveness of biodegradation for PCBs (Aroclor 1262 and 1268) is relatively unproven and data are limited.

Implementability – The equipment and resources necessary to conduct ex situ biodegradation are readily available, and several vendors are capable of performing this work. Aerobic biodegradation is an implementable technology for study area soils. However, due to the concentrations of difficult-to-degrade contaminants, the throughput capacity of the units is expected to be relatively low for treating the soil, sediments, and waste materials. If treatment is conducted at an in-town location, space is necessary to build or stage treatment equipment; constraints such as meeting TSD facility requirements and facility monitoring are also concerns. If the treatment is conducted at an out-of-town location, few, if any, facilities would be able to treat this waste. Lack of out-of-town treatment capacity effectively limits consideration of bioremediation to in-town processes.

Cost – The relative capital and O&M costs are low for in situ and ex situ aerobic biodegradation.

Conclusions – Because of concerns about the effectiveness of this process for several study area contaminants and the anticipated low throughput capacity for treating the soils, sediments, and waste materials, aerobic bioremediation is eliminated from further consideration.

2.4.7 Consolidation

Consolidation is an option in which soils, wetland soils, and sediments from different Raymark OUs would be relocated and consolidated in one in-town location. Consolidation makes it possible to address soils and sediments from various source areas in order to manage more effectively the larger volume of waste as a whole.

Effectiveness – Consolidation of soils and sediments optimizes "Raymark-wide" options by allowing one location to be used for treatment or containment. Since the materials would only be transported a short distance within the Town of Stratford and the exposure pathways are addressed by other actions, minimal health concerns would be associated with consolidating the soils. Consolidation alone would not achieve RAOs, but combined with other remedial actions, could facilitate meeting RAOs.

Implementability – No permits are required for consolidation, and issues such as availability of TSD facilities are not applicable. The consolidation would be conducted using readily available construction equipment, and would only be considered for an in-town location.

Cost – Consolidation of wastes at an in-town location will require, at a minimum, a containment or treatment option. However, by consolidating the material and having one location for containment or treatment instead of multiple locations, significant cost savings can be realized. The cost for consolidation itself, not including the containment or treatment option, would only include transportation and would be low.

Conclusion – Consolidation of soils, wetland soils, and sediments would be effective and implementable, provided the materials are contained or treated by other actions. As a result, in-town consolidation will be retained for further consideration.

2.4.8 Other

Other technologies and process options may be identified for additional screening prior to remediation. These technologies, if appropriate, can be incorporated into future evaluations of study area technologies.

2.5 Retained Technologies and Process Options

Following the initial screening presented in Table 2-7, the retained technologies are presented in Table 2-8 along with unit costs. The cost information presented includes only the unit rates for the specific technologies without considering other components, including costs for site preparation, mobilization, analytical results, administration, etc. This allows broad-scale costs comparison between technologies that can be used when assembling alternatives during the Feasibility Study.

3.0 FUTURE ASSEMBLY OF ALTERNATIVES

The next step of the Feasibility Study process will be to take the retained process options and combine them to form alternatives for the site as a whole, although this step is not performed in this Technical Memorandum. To assemble alternatives, general response actions should be combined using different technology types and different volumes of media and/or areas of the site. Often more than one general response action is applied to each medium. For example, alternatives for remediating soil contamination will depend on the type and distribution of contaminants and may include thermal desorption of soil from some portions of the site and capping of others.

Alternatives should be defined to provide sufficient quantitative information to allow differentiation among alternative with respect to effectiveness, implementability, and cost. Parameters that often require additional refinement include the extent or volume of contaminated material and the size of process options selected.

After the alternatives have been refined with respect to volumes or media, the technology process options need to be defined fully with respect to their effectiveness, implementability, and cost such that differences among alternatives can be identified. The following information should be developed, as appropriate, for the various technology processes used in an alternative:

- Size and configuration of treatment systems or containment structures. For media contaminated with several hazardous substances, it may be necessary to run pilot tests to first determine which contaminants impose the greatest treatment requirements prior to sizing or configuring accordingly.

- Time frame in which treatment, containment, or removal goals can be achieved. The remediation time frame is often interdependent on the size or configuration of a treatment system. The time frame may be influenced by technological limitations (such as maximum size consideration, performance capabilities, and/or availability of adequate treatment systems or disposal capacity).

- Rates or flows of treatment. These will also influence the sizing of technologies and time frame within which remediation can be achieved.

- Spatial requirements for constructing treatment or containment technologies or for staging construction materials or excavated soil or waste.

- Distances for disposal technologies. These include approximate transport distances to an acceptable off-site treatment and disposal facilities and distances for water pipelines for discharge to a receiving stream or a POTW.

- Required permits for off-site actions and imposed limitations – These include National Pollutant Discharge Elimination System (NPDES), pretreatment, and emission control requirements, coordination wit local agencies and the public, and other legal considerations. These may also encompass some action-, location-, and chemical-specific ARARs.

- Adjustment of technology design based on the limitations imposed by ARARs.

TABLES

TABLE 2-1A
POTENTIAL CHEMICAL-SPECIFIC ARARs AND TBCs
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK
STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
Federal Regulatory Requirements	NESHAPS (40 CFR 61 Subpart M (61.45, 61.150, 61.151, 61.154)	To be determined	This regulation defines asbestos.	Asbestos wastes will be handled as detailed as detailed in this regulation.
State Regulatory Requirements	Connecticut Cleanup Standard Regulations (22a-133 CGS)	Applicable	The regulations define minimum hazardous waste site remediation standards, specify numeric criteria for cleanup of soils and groundwater, and specify a process for establishing alternative, site-specific cleanup standards.	The regulations will be adhered to when determining soil cleanup standards under the capping scenario.
	Disposition of PCBs (22a-467 CGS)	Applicable	This section requires that PCBs be disposed under a permit issued by the Commissioner or with written approval of the Commissioner in a manner not inconsistent with the federal Toxic Substances Control Act (40 CFR 761).	The disposal of PCB contaminated soil will comply with the substantive provisions of this section.
	Connecticut Coastal Management Act (22a – 90 to 112)	To Be Determined	This statute establishes Connecticut's enforceable coastal zone policies in accordance with the federal Coastal Zone Management Act.	Activities performed in coastal areas would conform to these requirements.
Criteria, Advisories, and Guidance	TSCA PCB Spill Clean-up Policy (40 CFR 761.120-135)	To Be Determined	This policy applies to recent PCB spills and establishes clean-up levels for PCB spills of 50 ppm or greater at 10 ppm for non-restricted access areas and 25 ppm for restricted access areas.	Standards may be used as guidelines for soil cleanup if PCB contamination must be addressed.
	EPA Risk Reference Doses (RfDs)	To Be Determined	RfDs are dose levels developed by EPA for use in estimating the non-carcinogenic effects of exposure to toxic substances.	EPA RfDs were used to assess health risks due to exposure to noncarcinogenic contaminants present at the site. RfDs will be used in development of Preliminary Remediation Goals for facility soils.

TABLE 2-1A (cont.)
POTENTIAL CHEMICAL-SPECIFIC ARARs AND TBCs
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK
STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION
	Proposal for the Connecticut Cleanup Standard Regulations (22a-133K CGS)	To Be Determined	The proposed regulations would define minimum hazardous waste site remediation standards, specify numeric criteria for cleanup of soils and groundwater, and specify a process for establishing alternative, site-specific cleanup standards.	The proposed regulations will be considered in determining soil cleanup standards.
Criteria, Advisories, and Guidance	EPA Carcinogen Assessment Group Potency Factors	To Be Determined	EPA Carcinogenic Potency Factors (CPFs) are used to compute the individual incremental cancer risk resulting from exposure to carcinogens.	CPFs were used to assess health risks due to exposure to carcinogens present at the site. These factors will also be used in development of PRGs for site soils.
	Guidance on Remedial Actions at Superfund Sites with PCB Contamination (EPA/540/G-90/007, August 1990)	To Be Determined	Describes various scenarios and considerations pertinent to determining the appropriate level of PCBs that can be left in each contaminated media to achieve protection of human health and the environment.	This guidance will be considered in determining the appropriate level of PCBs that may be left in the soil.

Notes:

(1) Determination of the status of the requirement (i.e., applicable, relevant and appropriate, or to be considered) will be made for the individual alternatives and will be indicated on the alternative-specific ARARs tables in Section 4.0.

TABLE 2-1B
POTENTIAL ACTION-SPECIFIC ARARs AND TBCs
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREEING
RAYMARK
STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION[2]
Federal Regulatory Requirements	RCRA - General Facility Standards (40 CFR 264.10 – 264.18)	To Be Determined	General facility requirements outline general waste analysis, security measures, inspections, and training requirements.	Any on-site treatment, storage, or disposal facility will be constructed, fenced, posted and operated in accordance with the substantive provisions of this requirement
	RCRA – Preparedness and Prevention (40 CFR 264.30 – 264.37)	To Be Determined	Outlines requirements for safety equipment and spill control.	Safety and communication equipment will be maintained at the site and local authorities will be familiarized with the site operations, in accordance with the substantive provisions of these requirements.
	RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 – 264.56)	To Be Determined	Outlines requirements for emergency procedures to be used following explosions, fires, etc.	Contingency plans will be developed and response activities will be implemented in accordance with the substantive provisions of these requirements.
	RCRA – Groundwater Monitoring (40 CFR 264.90 – 264.93)	To Be Determined	Details requirements for groundwater monitoring and responding to releases from Solid Waste Management Units.	A groundwater monitoring program must be developed in accordance with the substantive provisions of these requirements for any alternative which involves an on-site surface impoundment, landfill, or land treatment facility.
	RCRA – Closure and Post-Closure (40 CFR 265.110 - 264.120)	To Be Determined	Details requirements for closure and post-closure of hazardous waste facilities.	Any containment remedy will be designed to meet the substantive provisions of this requirement.
	RCRA - Land Treatment (40 CFR 264.271 – 264.282)	To Be Determined	These regulations detail the requirements for conducting land treatment of RCRA hazardous waste.	Alternatives that involve on-site land treatment of contaminated soil must comply with the substantive provisions of these regulations.

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION[2]
Federal Regulatory Requirements (Continued)	RCRA – Closure of Landfill (40 CFR 264.310)	To Be Determined	This regulation details the closure and post-closure requirements for a landfill.	Alternatives that include on-site landfilling must meet the substantive closure requirements of this regulation.
	RCRA – On- site Landfills (40 CFR 264.300 – 264-309)	To Be Determined	Includes requirements for the design, construction, operation and maintenance of an RCRA Landfill	The disposal of RCRA waste in an on-site landfill must meet these requirements
	RCRA – Incineration (40 CFR 264.341 - 264.345)	To Be Determined	These regulations detail operating and monitoring requirements and impose performance standards for hazardous waste incinerators.	Alternatives that include incineration of contaminated soil must comply with the substantive provisions of these regulations. These standards may be applicable to alternatives including thermal desorption of soils or thermal oxidation of air emissions from soil treatment.
	RCRA Miscellaneous Treatment Units (40 CFR 264.601)	To Be Determined	This regulation details design and operating standards for units in which hazardous waste is treated.	Hazardous waste treatment units used for on-site treatment of contaminated media must meet the substantive provisions of these requirements.
	Land Disposal Restrictions (40 CFR 268)	To Be Determined	This regulation establishes "treatment standards" (concentration levels or methods of treatment) which wastes must meet in order to be eligible for land disposal.	Contaminated soil must be treated to attain applicable "treatment standards" prior to placement in a landfill, or other land disposal facility outside the area of contamination where placement occurs.

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION[2]
Federal Regulatory Requirements (Continued)	TSCA - PCB Storage and Disposal (40 CFR 761.60, .75, .79)	To Be Determined	This regulation establishes standards for the storage, disposal, and incineration of PCBs at a concentration greater than 50 ppm.	Storage, incineration, and disposal of PCB contaminated soil must be conducted in conformance with the substantive provisions of these regulations.
	CWA National Pollutant Discharge Elimination System (NPDES) (40 CFR 122, 125)	To Be Determined	Any point-source discharge must meet NPDES requirements which include compliance with corresponding water quality standards; establishment of a discharge monitoring system; and completions of regular discharge monitoring records.	If an alternative involves treatment, and discharge of process water or groundwater collected during dewatering, discharges to surface water will need to comply with the substantive provisions of these regulations.
	CWA Pre-treatment Regulations (40 CFR 403)	To Be Determined	These regulations impose restrictions on the discharge of pollutants to Publicly Owned Treatment Works (POTW) and mandate that discharges must comply with the local pretreatment program.	If an alternative involves treatment and discharge of an aqueous waste stream from treatment process operation or dewatering, discharges to a POTW must comply with these regulations.
	RCRA - Air Emission Standards for Process Vents (40 CFR 265 Subpart AA)	To Be Determined	Standards for air emissions from process vents associated with selected processes including solvent extraction, and air or steam stripping operations that treat RCRA substances and have total concentrations of 10 ppm or greater.	Alternatives involving solvent extraction of facility soils will comply with the substantive portions of these regulations if threshold organic concentrations are met.
	RCRA, Air Emission Standards for Equipment Leaks, (40 CFR, 265, Subpart BB)	To Be Determined	Standards for air emissions for equipment that contains or contacts RCRA waste with organic concentrations of at least 10% by weight.	All remedial alternatives which include equipment for treatment of organics will comply with substantive portions of the regulation if the threshold organic concentration is met.

AUTHORITY	REQUIREMENT	STATUS(1)	REQUIREMENT SYNOPSIS	CONSIDERATION(2)
Federal Regulatory Requirements (Continued)	RCRA, Air Emissions from TSDFs, (40 CFR, Part 265, Subpart CC) (Proposed 56 Fed Reg. 33490-33598, 7/22/91)	To Be Determined	Proposed standards for air emissions from treatment, storage, disposal facilities with VOC concentration equal to or greater than 500 ppm.	Proposed standards will be considered for all remedial alternatives if threshold VOC concentrations are met.
	CAA NAAQS for Particulate Matter (40 CFR 50.6)	To Be Determined	The particulate matter NAAQS specifies maximum primary and secondary 24 hour concentrations for particulate matter in the ambient air. These ambient air concentrations are not designed to apply to specific sources; rather, states may promulgate State Implementation Plan emission limits applicable to sources, which will result in attainment and maintenance of the NAAQS. Connecticut has not promulgated any particulate matter emission limits applicable to this source.	Fugitive dust emissions from site excavation and handling activities will be minimized with dust suppressants, if necessary. These measures should be sufficient to prevent any exceedances in the ambient air of the 150 $\mu g/m^3$ 24 hour primary standard for particulate matter.
	CAA NESHAPS (40 CFR 61 Subpart M (61.145, 61.150, 61.151, 61.154)	To Be Determined	These regulations specify requirements regarding removal, management, and disposal of asbestos.	Handling, treatment, and disposal of soils containing asbestos and building demolition debris containing asbestos must comply with the substantive provisions of these regulations.

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION[2]
State Regulatory Requirements	Connecticut Air Pollution Regulations - Stationary Sources (Sec. 22a-174-3 RCSA)	To Be Determined	Requires that stationary sources of air pollutants meet specified standards prior to construction and operation. Prohibits operation of sources that interfere with attainment of Air Quality Standards.	For alternatives that may result in air emission (i.e., thermal treatment, solvent extraction, capping), and constitute a stationary source, the gas collection and treatment system will be designed to meet substantive standards established under these regulations.
	Connecticut Air Pollution Regulations (Sec. 22a-174-4, 22a-174-5, and 22a-174-7 RCSA)	To Be Determined	These sections specify air emissions monitoring requirements, emissions sampling and analysis methods, and general air pollution control equipment operation requirements.	Operation and monitoring of alternatives that include emission controls systems will be conducted in accordance with the substantive requirements of these regulations.
	Connecticut Air Pollution Regulations - Fugitive Dust Emissions (RCSA 22a-174-18b)	To Be Determined	Requires that reasonable precautions be taken to prevent particulate matter from becoming airborne during demolition and construction activities and material handling operations.	Activities involving building demolition, soil excavation or handling, and cap construction must be conducted in a manner to minimize fugitive dust emissions from the Facility.
	Connecticut Air Pollution Regulations - Incineration (RCSA 22a-174-18c)	To Be Determined	Establishes regulations and emission rates for incinerators.	For alternatives that include thermal treatment, the vapor collection and treatment system will be designed to meet substantive standards established under these regulations.
	Connecticut Air Pollution Controls - Control of Odors (Sec. 22a-174-23 RCSA)	To Be Determined	This regulation prohibits emission of substances that constitute nuisances because of objectional odors. Several compounds have specific concentration limits.	Alternatives that result in the emission of regulated compounds would need to comply with the substantive requirements of the regulation.

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION[2]
State Regulatory Requirements (Continued)	Connecticut Air Pollution Regulations - Hazardous Air Pollutants (RCSA 22a-174-29)	To Be Determined	Establishes testing requirements and allowable concentrations for any stack emission for the constituents listed.	Alternatives that include treatment processes that result in air emissions must include emissions control systems designed and operated to meet the substantive requirements of these regulations.
	Connecticut Hazardous Waste Site Management Regulations (Sec. 22a-449 (c) - 105, RCSA)	To Be Determined	These regulations outline requirements for the management and disposal of hazardous wastes, and the construction, location, operation, and closure of hazardous waste treatment, storage, and disposal facilities. These regulations incorporate by reference substantial portions of 40 CFR 265 (RCRA).	Alternatives would comply with those portions of the regulations that are more stringent than the corresponding federal RCRA regulations cited herein.
	Connecticut Cleanup Standard Regulations (22a-133 CGS)	To Be Determined	The regulations define minimum hazardous waste site remediation standards, specify numeric criteria for cleanup of soils and groundwater, and specify a process for establishing alternative, site specific cleanup standards.	Alternatives would comply with portions of these regulations.
	Connecticut Water Quality Standards (issued pursuant to Sec. 22a-426 CGS)	To Be Determined	Establishes designated uses for groundwater and identifies the criteria necessary to support these uses.	Alternatives would comply with water quality standards since actions are taken to minimize further degradation of groundwater.

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION[2]
State Regulatory Requirements (Continued)	Connecticut Hazardous Waste Site Management Regulations (Sec. - 22a-449(c)-105 RCSA)	To Be Determined	These regulations outline requirements for the management and disposal of hazardous wastes, and the construction, location, operation, and closure of hazardous waste treatment, storage, and disposal facilities. These regulations incorporate by reference substantial portions of 40 CFR 264 (RCRA).	Those portions of the regulations that are more stringent than the corresponding federal RCRA regulations cited herein will be complied with.
	Connecticut Hazardous Waste Management: Land Disposal Restrictions (RCSA 22a-449(c)(108))	To Be Determined	This section incorporates by reference the federal Land Disposal Restrictions (40 CFR 268).	RCRA waste must be treated to attain applicable standards prior to placement in a landfill outside the area of contamination.
	Connecticut Water Quality Standards (Issued Pursuant to Sec. 22a-426 CGS)	To Be Determined	Establishes designated uses for groundwater and surface water and identifies the criteria necessary to support these uses.	Remedial alternatives will be designed to minimize further degradation of groundwater and surface water. If an alternative involves discharge of an aqueous waste stream from soil treatment or dewatering, discharges to surface water will be treated to prevent degradation of surface water.
	Connecticut Discharge of Storm Water Associated with Industrial Activity (Sec. 22a-430-1 to -8, RCSA; Sec. 22a-430b, 22a-430, CGS)	To Be Determined	These regulations establish permitting and monitoring requirements for discharges to surface water, groundwater, and POTWs.	Alternatives involving discharge of an aqueous waste stream will need to comply with the substantive provisions of these regulations. If the discharge is considered "off-site", permitting requirements will have to be met.

AUTHORITY	REQUIREMENT	STATUS[1]	REQUIREMENT SYNOPSIS	CONSIDERATION[2]
State Regulatory Requirements (Continued)	Connecticut - Discharge of Stormwater Associated with Industrial Activity (Sec. 22a-430-1 to -8, RCSA; Sec. 22a-430b, 22a-430, CGS)	To Be Determined	Establishes permit, monitoring, and reporting requirements for the management and discharge of storm waters.	Alternatives that result in discharge of surface run-off or precipitations will need to comply with the substantive requirements of the regulation.
Criteria, Advisories, Guidance	TSCA PCB Spill Clean-up Policy (40 CFR 761.120-135)	To Be Considered	This policy applies to recent PCB spills and establishes cleanup levels for PCB spills of 50 ppm or greater at 10 ppm for non-restricted access areas and 25 ppm for restricted access areas.	These clean-up levels may be used as guidelines for soil cleanup at the Raymark facility.
	Guidance on Remedial Actions of Superfund Sites with PCB Contamination (EPA/540/G-90/ 007, Aug. 1990)	To Be Considered	Describes various scenarios and considerations pertinent to determining the appropriate level of PCBs that can be left in each contaminated media to achieve protection of human health and environment.	This guidance will be considered in determining the appropriate level of PCBs that will be left in the soil. Management of PCB contamination residuals will be designed in accordance with the guidance.

AUTHORITY	REQUIREMENT	STATUS(1)	REQUIREMENT SYNOPSIS	CONSIDERATION(2)
Criteria, Advisories, Guidance (Continued)	CAA NAAQS for particulate matter (40 CFR 50.6)	To Be Considered	The particulate matter NAAQS specifies maximum primary and secondary 24 hour concentrations for particulate matter in the ambient air. These ambient air concentrations are not designed to apply to specific sources; rather, states may promulgate State Implementation Plan emission limits applicable to sources, which would result in attainment and maintenance of the NAAQS. Connecticut has not promulgated any particulate matter emission limits applicable to this source.	Fugitive dust emissions for soil-waste handling activities would be minimized with temporary enclosures and dust suppressants, if necessary. These measures should be sufficient to prevent any exceedances in the ambient air of the 150 $\mu g/m^3$ 24-hour primary standard for particulate matter.
	U.S. EPA Technical Guidance - Final Covers of Hazardous Waste Landfills and Surface Impoundments (EPA/530-SW-89-047)	To Be Considered	Provides technical specifications for the design of multi-layer covers at landfills where hazardous wastes were disposed.	This guidance will be considered in designing any cap and associated systems.
	Proposal for the Connecticut Cleanup Standard Regulations (22a-133K CGS)	To Be Considered	The proposed regulations would define minimum hazardous waste site remediation standards, specify numeric criteria for cleanup of soils and groundwater, and specify a process for establishing alternative, site specific cleanup standards.	The proposed regulations will be considered in determining soil cleanup standards.

Notes:

1) Determination of the status of the requirement (i.e., applicable, relevant and appropriate, or to be considered) will be made for the individual alternatives and will be indicated on the alternative-specific ARARs once alternatives are developed.
2) At the screening level, assume no additional waste is brought into the study area.

CGS - Connecticut General Statutes
RCSA - Regulation of Connecticut State Agencies

TABLE 2-1C
POTENTIAL LOCATION-SPECIFIC ARARs AND TBCs
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVE SCREENING
RAYMARK
STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Federal Regulatory Requirements	Protection of Wetlands (Executive Order 11990), 40 CFR 6.302(a) and 40 CFR 6, App. A (Policy on Implementing E.O. 11990)	To Be Considered	Federal agencies are required to avoid undertaking or providing assistance for new construction located in wetlands unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use.	Remedial alternatives that involve excavation or deposition of materials in the lagoon/ wetland system would include all practicable means of minimizing harm to wetlands. Wetlands protection consideration would be incorporated into the planning and decision-making for remedial alternatives.
	Floodplain Management (Executive Order 11988, 40 CFR 6.302(b) and 40 CFR 6, App. A (Policy on Implementing E.O. 11988)	To Be Considered	Federal agencies are required to avoid impacts associated with the occupancy and modification of a floodplain and avoid support of floodplain development wherever there is a practicable alternative.	The potential effects on the floodplain will be considered during the development and evaluation of remedial alternatives. All practicable measures would be taken to minimize adverse effects on floodplains.
	RCRA Floodplain Restrictions for Hazardous Waste Facilities (40 CFR 264.18(b))	To Be Considered	A hazardous waste facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout or to result in no adverse effects on human health or the environment if washout were to occur.	The remedial alternatives must ensure that the hazardous waste facilities located in the floodplain would comply with these requirements.
	CWA - Dredge and Fill Regulations (40 CFR 230; 33 CFR 320-330)	To Be Considered	These regulations, also known as the CWA Section 404(b)(i) Guidelines, outline requirements for the discharge of dredged or fill materials into surface waters, including wetlands. Under these requirements, no activity that impacts a wetland shall be permitted if a practicable alternative, which would have less adverse impact, exists.	Controls would be used to minimize adverse impacts to the wetlands.
	Fish and Wildlife Coordination Act (16 U.S.C. 661)	To Be Considered	This regulation requires that any Federal agency that proposes to modify a body of water must take action to prevent, mitigate or compensate for project-related losses of fish and wildlife resources.	Controls would be used to minimize adverse impacts to the wetlands. EPA would ensure that losses to fish and wildlife resources are prevented, mitigated or compensated and that the U.S. Fish and Wildlife Service would be consulted.
	Endangered Species Act (16 USC 1531 <u>et seq.</u>; 40 CFR 6.302(h))	To Be Considered	This statute requires that Federal agencies avoid activities which jeopardize threatened or endangered species or adversely modify habitats essential to their survival. Mitigation measures should be considered if a listed species or habitat may be jeopardized.	Construction of the collection and containment systems would be conducted to ensure that any listed species or habitat identified in the area of the site would not be adversely affected.

TABLE 2-1C (cont.)
POTENTIAL LOCATION-SPECIFIC ARARs AND TBCs
REMEDIAL ALTERNATIVE SCREENING
RAYMARK
STRATFORD, CONNECTICUT

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Federal Regulatory Requirements (cont'd)	An Act Relating to the Preservation of Historical and Archeological Data (16 USC 469a-1)	To Be Considered	This statute requires that, whenever any Federal agency finds or is made aware that its activity in connection with any construction project or federally licensed project, activity or program may cause irreparable loss or destruction of significant scientific, prehistorical, historical, or archeological data, such agency shall undertake the recovery, protection and preservation of such data or notify the Secretary of Interior. The undertaking could include a preliminary survey (or other investigation as needed) and analysis and publication of the reports resulting from such investigation.	If significant scientific, prehistorical, historical, or archeological data are encountered during soil excavation, steps would be implemented to recover, protect and preserve such data.
	Archeological Resources Protection Act (16 USC 470aa-mm, 36 CFR 296, 32 CFR 229, 43 CFR7, and 18 CFR 1312)	To Be Considered	This regulation develops procedures for the protection of archeological resources.	If archeological resources are encountered during soil excavation, they would be reviewed by Federal and State archaeologists. This requirement is applicable to any excavation onsite.
Criteria, Advisories, Guidance	U.S. EPA Memorandum, "Policy on Floodplains and Wetland Assessments for CERCLA Actions" (Aug. 6, 1985)	To Be Considered	This guidance discusses situations that require preparation of a floodplains or wetlands assessment, and the factors which should be considered in preparing an assessment, for response actions undertaken pursuant to section 104 or 106 of CERCLA.	This guidance will be considered during the development, evaluation and selection of alternatives that involve disturbance, alteration or destruction of floodplains or wetlands.
	Memorandum of Agreement (MOA) between EPA and the U.S. Department of the Army	To Be Considered	This notice provides clarification and general guidance regarding the level of mitigation necessary to demonstrate compliance with the Clean Water Act section 404(b)(1) Guidelines.	This guidance will be considered during the development, evaluation and selection of alternatives that involve disturbance, alteration or destruction of wetlands.
	Guidance on Flexibility of the 404(b)(1) Guidelines	To Be Considered	This document provides guidance on the flexibility that the U.S. Army Corps of Engineers should be utilizing when making determinations of compliance with the Section 404(b)(1) Guidelines, and guidance on the use of mitigation banks as a means of providing compensatory mitigation for Corps regulatory decisions.	This guidance will be considered during the development, evaluation and selection of alternatives that involve disturbance, alteration or destruction of wetlands.

TABLE 2-2A
SUMMARY OF TOTAL RISK LEVELS AND HAZARD INDICES
AREA D COMMERCIAL ALL SOILS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK - OU8
STRATFORD, CONNECTICUT

Contaminant of Concern	Representative Concentration For The RME Receptor	Incremental Lifetime Cancer Risk Levels for RME Receptor Commercial Worker			Hazard Quotients for RME Receptor Commercial Worker		
		Incidental Ingestion	Dermal Contact	All Pathways	Incidental Ingestion	Dermal Contact	All Pathways
SVOCs (mg/kg)							
Benzo(a)pyrene	9	2.3E-05	1.5E-05	3.8E-05	NA	NA	NA
PCBs (mg/kg)							
Aroclor, Total	69	4.8E-05	3.4E-05	8.2E-05	3.4E+00	2.4E+00	5.8E+00
Metals (mg/kg)							
Arsenic	35.5	1.9E-05	2.8E-06	2.2E-05	1.2E-01	1.7E-02	1.4E-01
Chromium	3560				1.2E+00	NA	1.2E+00
Lead		NA	NA	NA	NA	NA	NA
Dioxins (mg/kg)							
Dioxin TEQ	0.0078	4.1E-04	2.0E-06	4.1E-04	NA	NA	NA
Total RL =		5.0E-04	5.4E-05	5.5E-04	4.7E+00	2.4E+00	7.1E+00
Total RME CRL = Incidental Ingestion + Dermal Contact =							5.5E-04
Total RME HI = Incidental Ingestion + Dermal Contact =							7.1E+00

ABBREVIATIONS:
NA - Not Available
RL - Risk Level
CRL - Cancer Risk Level
HI - Hazard Index
RME - Reasonable Maximum Exposure

NOTES: Risk levels and hazard indices are for incidental ingestion and dermal contact by an individual worker according to future land use scenarios.

TABLE 2-2B
SUMMARY OF TOTAL RISK LEVELS AND HAZARD INDICES
AREA D WETLAND/MARSH SURFACE SOILS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK - OU8
STRATFORD, CONNECTICUT

Contaminant of Concern	Representative Concentration For The RME Receptor	Incremental Lifetime Cancer Risk Levels for RME Receptor Pre-adolescent Wetland/Marsh Receptor			Hazard Quotients for RME Receptor Pre-adolescent Wetland/Marsh Receptor		
		Incidental Ingestion	Dermal Contact	All Pathways	Incidental Ingestion	Dermal Contact	All Pathways
PCBs (mg/kg)							
Aroclor, Total	53	1.6E-06	7.2E-06	8.8E-06	4.7E-01	2.1E+00	2.6E+00
Total RL =		1.6E-06	7.2E-06	8.8E-06	4.7E-01	2.1E+00	2.6E+00

Total RME CRL = Incidental Ingestion + Dermal Contact = 8.8E-06

Total RME HI = Incidental Ingestion + Dermal Contact = 2.6E+00

ABBREVIATIONS:
NA - Not Available
RL - Risk Level
CRL - Cancer Risk Level
HI - Hazard Index
RME - Reasonable Maximum Exposure

TABLE 2-2C
SUMMARY OF TOTAL RISK LEVELS AND HAZARD INDICES
AREA E WETLAND/MARSH SURFACE SOILS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK - OU8
STRATFORD, CONNECTICUT

Contaminant of Concern	Representative Concentration For The RME Receptor	Incremental Lifetime Cancer Risk Levels for RME Receptor Pre-adolescent Wetland/Marsh Receptor			Hazard Quotients for RME Receptor Pre-adolescent Wetland/Marsh Receptor		
		Incidental Ingestion	Dermal Contact	All Pathways	Incidental Ingestion	Dermal Contact	All Pathways
PCBs (mg/kg)							
Aroclor, Total	70	2.1E-06	9.5E-06	1.2E-05	6.2E-01	2.8E+00	3.4E+00

Total RL =	2.1E-06	9.5E-06	1.2E-05	6.2E-01	2.8E+00	3.4E+00

Total RME CRL = Incidental Ingestion + Dermal Contact =	1.2E-05
Total RME HI = Incidental Ingestion + Dermal Contact =	3.4E+00

ABBREVIATIONS:
NA - Not Available
RL - Risk Level
CRL - Cancer Risk Level
HI - Hazard Index
RME - Reasonable Maximum Exposure

TABLE 2-2D
SUMMARY OF TOTAL RISK LEVELS AND HAZARD INDICES
AREA E SURFACE WATER
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK - OU8
STRATFORD, CONNECTICUT

Contaminant of Concern	Representative Concentration For The RME Receptor	Incremental Lifetime Cancer Risk Levels for RME Receptor Pre-adolescent Wetland/Marsh Receptor	Hazard Quotients for RME Receptor Pre-adolescent Wetland/Marsh Receptor
		Dermal Contact	Dermal Contact
PCBs (ug/L)			
Aroclor, Total	7	2.8E-05	8.2E+00

Total RL =	2.8E-05	8.2E+00
Total RME CRL = Dermal Contact =		2.8E-05
Total RME HI = Dermal Contact =		8.2E+00

ABBREVIATIONS:
NA - Not Available
RL - Risk Level
CRL - Cancer Risk Level
HI - Hazard Index
RME - Reasonable Maximum Exposure

TABLE 2-3A
SOIL/SEDIMENT CONTAMINANTS OF CONCERN
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

CONTAMINANTS OF CONCERN	HUMAN CARCINOGEN COC(1)	HUMAN NON-CARCINOGEN COC(1)
SEMI-VOLATILE ORGANIC COMPOUNDS		
Benzo(a)pyrene	X	-
PCBs		
Aroclor (total)	X	X
INORGANICS		
Arsenic	X	X
Asbestos	(2)	(2)
Chromium	-	X
Lead	(2)	(2)
DIOXINS		
Dioxin TEQs	X	-

Notes:

1) Human COCs selected if exposure causes cancer risk in excess of 1×10^{-5} for carcinogens, or has a Hazard Quotient of greater than 1.0 for non-carcinogens.

2) Asbestos and lead pose carcinogenic and non-carcinogenic health threats; there is insufficient risk data to quantify health risks. However, both are retained as human health COCs.

COC = Contaminant of concern

TABLE 2-3B
SURFACE WATER CONTAMINANTS OF CONCERN
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

CONTAMINANTS OF CONCERN	HUMAN CARCINOGEN COC(1)	HUMAN NON-CARCINOGEN COC(1)
PCBs		
Aroclor (total)	-	X

Notes:

1) Human COCs selected if exposure causes cancer risk in excess of 1×10^{-5} for carcinogens, or has a Hazard Quotient of greater than 1.0 for non-carcinogens.

COC = Contaminant of concern

TABLE 2-4A
POTENTIAL SOIL/SEDIMENT PRELIMINARY REMEDIATION GOALS FOR CONTAMINANTS OF CONCERN
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

Contaminant	Risk-Based (1)	Conn. Pollutant Mobility Criteria (2)	Background (3)	CRQL/ CRDL (4)	ARARs/TBCs
Semi-volatile Organic Compounds (mg/kg)					
Benzo(a)pyrene	2.376	1	NA	0.33	NA
PCBs (mg/kg)					
Aroclor (total)	8.42/20.65	0.005 mg/L +	NA	0.033	25 (5)
Inorganics (mg/kg)					
Arsenic	16.6	0.5 mg/L +	5.7	2	NA
Asbestos	NA	NA	NA	---	1% (6)
Chromium	3,066	0.5 mg/L +	17	2	NA
Lead	NA	0.15 mg/L +	81	0.6	1,000 (7)
Dioxins (mg/kg)					
Dioxin TEQs	0.0002	NA	NA	NA	0.001 (8)

NOTES:

NA Not applicable
--- Not available
+ Value is in mg/L and should be compared to TCLP or SPLP analyses presented in the RI.

(1) Risk-based PRG values were developed for the protection of human health. Only commercial values were calculated except for total aroclors, for which a value based on wetland/marsh receptors is also provided. A PRG value of 8.42 mg/kg is recommended for commercial soils in Area D; a value of 20.65 mg/kg is recommended for wetland/marsh area soils and sediments in Areas D and E.
(2) Numeric criteria from the Remediation Standard Regulations, Connecticut Department of Environmental Protection. Value is for Pollutant Mobility for GB aquifer areas. For PCBs and inorganic contaminants, the value is the Pollutant Mobility Criteria for GB groundwater by TCLP or SPLP in mg/L.
(3) Background soil concentrations were calculated for metals based on mean values.
(4) EPA Contract Laboratory Program Contract Required Quantitation Limit (CRQL) and Contract Required Detection Limit (CRDL) values for organics and inorganics, respectively.
(5) OSWER Directive No. 9355.4-01, Guidance on Remedial Actions for Superfund Sites with PCB Contamination, August 1990 suggests an acceptable value of 25 mg/kg PCBs for commercial sites.
(6) NESHAPs - 40 CFR Section 61, subsection M identifies materials containing 1 percent or greater asbestos would need to be addressed in accordance with regulations.
(7) OSWER Directive No. 9355.4-12, Revised Interim Guidance on Establishing Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, July 1994 recommends a PRG value of 1,000 mg/kg for commercial/industrial sites.
(8) OSWER Directive No. 9200.4-26, Approaches for Addressing Dioxins in Soil at CERCLA and RCRA sites, April 1998 presents a 0.001 mg/kg dioxin clean-up level.

TABLE 2-4B
POTENTIAL SURFACE WATER PRELIMINARY REMEDIATION GOALS FOR CONTAMINANTS OF CONCERN
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

Contaminant	Risk-Based (1)	CRQL/ CRDL (2)	ARARs/TBCs
PCBs (mg/L)			
Aroclor (total)	0.00085	0.001	NA

NOTES:

NA Not applicable
--- Not available

(1) Risk-based PRG values were developed for the protection of human health. Only recreational values were calculated. Calculations of the risk-based PRGs are presented in Appendix B.

(2) EPA Contract Laboratory Program Contract Required Quantitation Limit (CRQL) and Contract Required Detection Limit (CRDL) values for organics and inorganics, respectively.

TABLE 2-5A
SELECTED SOIL/SEDIMENT PRELIMINARY REMEDIATION GOALS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

Contaminant	Preliminary Remediation Goal	Basis of Selection
Semi-volatile Organic Compounds (mg/kg)		
Benzo(a)pyrene	2.376	Risk-based
PCBs (mg/kg)		
Aroclor (total)	25	ARAR/TBC
Inorganics (mg/kg)		
Arsenic	16.6	Risk-based
Asbestos	1%	ARAR/TBC
Chromium	3,066	Risk-based
Lead	1,000	ARAR/TBC
Dioxins		
Dioxin TEQs	0.001	ARAR/TBC

TABLE 2-5B
SELECTED SURFACE WATER PRELIMINARY REMEDIATION GOALS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

Contaminant	Preliminary Remediation Goal	Basis of Selection
PCBs (mg/kg)		
Aroclor (total)	0.001	CRQL

TABLE 2-6
RAOs, GRAs, TECHNOLOGIES AND PROCESS OPTIONS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES	PROCESS OPTIONS
ENVIRONMENTAL MEDIUM: SOILS			
PROTECTION OF HUMAN HEALTH PROTECTION OF ECOLOGICAL RECEPTORS PROTECTION OF GROUNDWATER	No Action	No Action	Not Applicable
	Limited Action	Limited Action Technologies – Institutional Controls – Access Restrictions – Long-Term Monitoring	– Deed Restrictions – Local Ordinances – Fencing – Post Signs – Groundwater Monitoring
	Soil Removal	Removal Technologies - Excavation	– Bulk Mechanical Excavation
	Soil Disposal	Disposal Technologies - Landfill	– Landfill (off-site) – Landfill (on-site)
	Soil Containment	Containment Technologies - Horizontal Barriers - Vertical Barriers	– Impermeable Cap – Permeable Soil Cover – Sheet Pile – Slurry Wall
	Soil Treatment	Treatment Technologies – Immobilization – Thermal Treatment – Physical Treatment – Chemical Treatment – Biological Treatment	– Solidification/Stabilization – Microencapsulation – Incineration – Pyrolysis – Thermal Desorption – Super Critical Water Oxidation – Vitrification – Soil Flushing – Soil Washing – Liquefied Gas Solvent Extraction – Soil Vapor Extraction

REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES	PROCESS OPTIONS
			– Electrokinetics – Chemical Dechlorination – Chemical Oxidation – Solvent Extraction – Aerobic Biodegradation – Anaerobic Biodegradation – Phytoremediation

TABLE 2-6 (cont.)
RAOs, GRAs, TECHNOLOGIES AND PROCESS OPTIONS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES	PROCESS OPTIONS
ENVIRONMENTAL MEDIUM: WETLAND SOILS			
PROTECTION OF HUMAN HEALTH PROTECTION OF ECOLOGICAL RECEPTORS PROTECTION OF GROUNDWATER	No Action	No Action	Not Applicable
	Limited Action	Limited Action Technologies – Institutional Controls – Access Restrictions – Long-Term Monitoring	– Deed Restrictions – Local Ordinances – Fencing – Post Signs – Groundwater Monitoring
	Wetland Soil Removal	Removal Technologies – Excavation – Dredging	– Bulk Mechanical Excavation – Mechanical Dredging – Hydraulic Dredging – Pneumatic Dredging
	Wetland Soil Disposal	Disposal Technologies	– Landfill (on-site) – Landfill (off-site)
	Wetland Soil Containment	Containment Technologies - Horizontal Barriers - Vertical Barriers	– Impermeable Cap – Permeable Soil Cover – Sheet Pile – Slurry Wall

TABLE 2-6 (cont.)
RAOs, GRAs, TECHNOLOGIES AND PROCESS OPTIONS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES	PROCESS OPTIONS
Cont'd	Wetland Soil Treatment	Treatment Technologies – Immobilization – Thermal Treatment – Physical Treatment – Chemical Treatment – Biological Treatment	– Solidification/Stabilization – Microencapsulation – Sorption – Incineration – Pyrolysis – Thermal Desorption – Super Critical Water Oxidation – Vitrification – Soil Flushing – Soil Washing – Liquefied Gas Solvent Extraction – Soil Vapor Extraction – Electrokinetics – Chemical Dechlorination – Chemical Oxidation – Solvent Extraction – Aerobic Biodegradation – Anaerobic Biodegradation – Phytoremediation

TABLE 2-6 (cont.)
RAOs, GRAs, TECHNOLOGIES AND PROCESS OPTIONS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES	PROCESS OPTIONS
ENVIRONMENTAL MEDIUM: FERRY CREEK SEDIMENTS			
PROTECTION OF HUMAN HEALTH PROTECTION OF ECOLOGICAL RECEPTORS PROTECTION OF GROUNDWATER	No Action	No Action	Not Applicable
	Limited Action	Limited Action Technologies – Institutional Controls – Access Restrictions – Long-Term Monitoring	– Deed Restrictions – Local Ordinances – Post Signs – Fencing – Groundwater Monitoring
	Sediment Removal	Removal Technologies – Excavation – Dredging	– Bulk Mechanical Excavation – Mechanical Dredging – Hydraulic Dredging – Pneumatic Dredging
	Sediment Disposal	Disposal Technologies	– Landfill (off-site) – Landfill (on-site)
	Sediment Containment	Containment Technologies – Horizontal Barriers – Vertical Barriers – Culvert	– Impermeable Cap – Permeable Soil/Rock Cover – Culvert Ferry Creek
	Sediment Treatment	Treatment Technologies – Immobilization – Thermal Treatment – Physical Treatment – Chemical Treatment – Biological Treatment	– Solidification/Stabilization – Microencapsulation – Sorption – Incineration – Pyrolysis – Thermal Desorption – Super Critical Water Oxidation – Vitrification

TABLE 2-6 (cont.)
RAOs, GRAs, TECHNOLOGIES AND PROCESS OPTIONS
DRAFT TECHNICAL MEMORANDUM
REMEDIAL ALTERNATIVES SCREENING
RAYMARK – OU8
STRATFORD, CONNECTICUT

REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES	PROCESS OPTIONS
			– Soil Flushing – Soil Washing – Liquefied Gas Solvent Extraction – Soil Vapor Extraction – Electrokinetics – Chemical Dechlorination – Chemical Oxidation – Solvent Extraction – Aerobic Biodegradation – Anaerobic Biodegradation – Phytoremediation